Canada Mortgage and Housing Corporation
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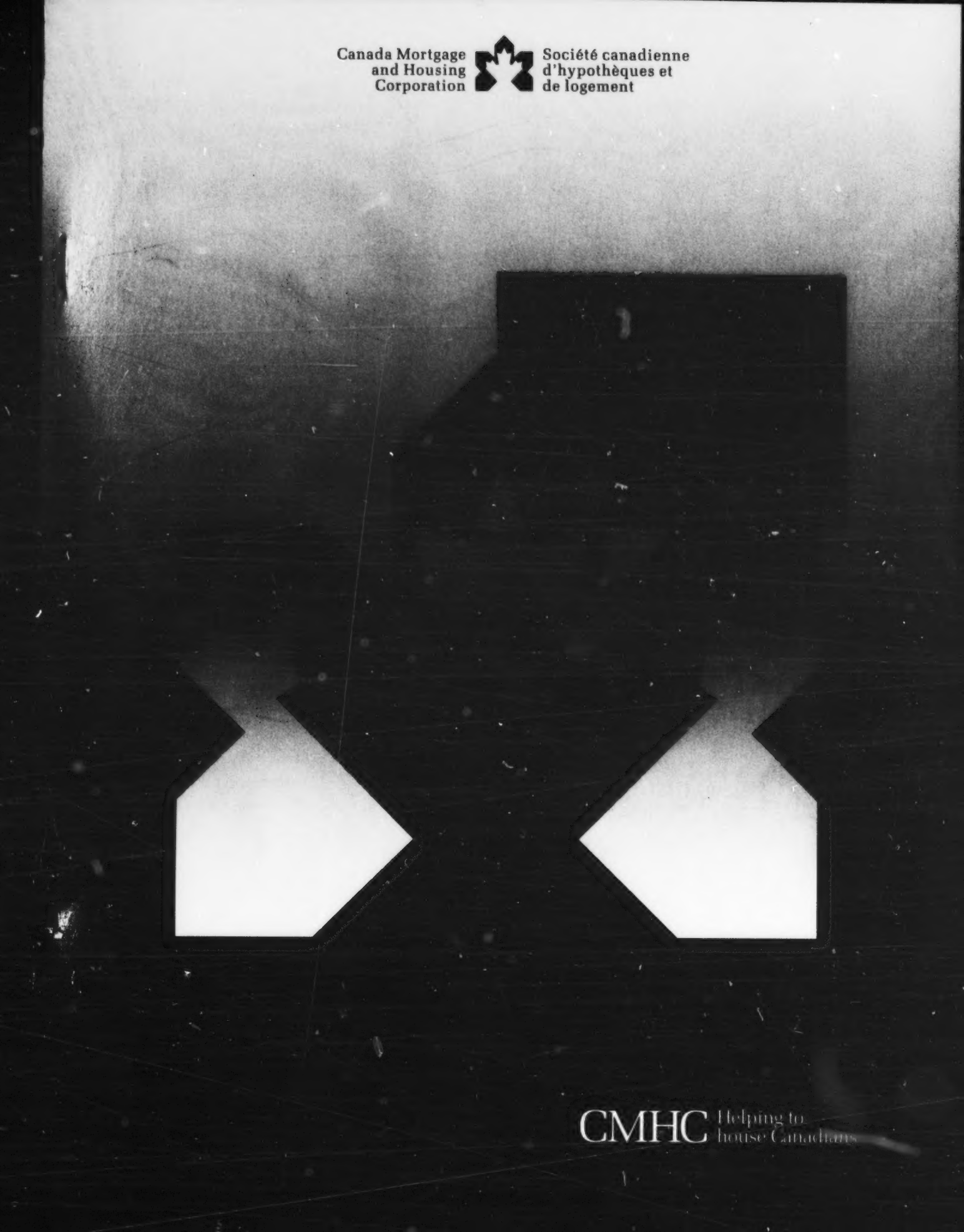

CMHC Helping to house Canadians

CMHC/EMR NORTHERN INITIATIVES

R-2000 HOME PROG. TECHNOLOGY PROJECT
NORTHWEST TERRITORIES HOUSING CORP.
TECHNICAL SUPPORT

INTERIM REPORT #3 AND
FINAL REPORT

CMHC/EMR NORTHERN INITIATIVES

R-2000 Home Program Technology Project
Northwest Territories Housing Corporation
Technical Support.

Interim Report #3 and Final Report

March 30, 1989

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ABSTRACT

In 1987, CMHC and EMR established a joint venture for the purpose of providing technical housing support to the Northwest Territories Housing Corporation. A contract person was hired to fill that position in January of 1988.

Over the past year, several activities and projects have been initiated to respond to technical housing need in the north. These include:

- expansion of the scope of technical support to include the Northwest Territories and Yukon Territory.

- the establishment of a secretariat for the NoRTH Committee.

- the development of a draft document titled the NoRTH file, a compendium of technical information on housing in the north

- the identification and field demonstration of alternative oil fired heating systems more appropriate for the northern climate.

- the field demonstration of ventilation systems for the northern climate including -40C HRV's and passive ventilation systems

- monitoring of wood moisture content in northern building envelopes

- demonstration of integrated heating and ventilation systems designed around guidelines prescribed by CSA Preliminary Draft F326.1

- development of fundamental algorithms for analysis of data being collected as part of the R2000 Level B monitoring program underway through EMR.

The joint venture between CMHC and EMR terminates on March 31, 1989. This report represents the final report summarizing the activities completed to March 31, 1989 as a result of this joint venture. Many of the field demonstration projects are underway and CMHC will continue to support the management of these projects to completion. It is anticipated that results from these projects will be available in the fall of 1990.

STATEMENT OF WORK

The work was coordinated through the CMHC office in Ottawa through a Northern Project Officer. The original contract was signed in December of 1987 and was to continue until December 31, 1988. In August of 1988, an amendment to the contract was made to extend the agreement to March 31, 1989. EMR contributed and additional $20,000 to the agreement to cover travel and salary.

Appendix "A" contains the amended contract.

Deliverables
The following is a list of deliverables as outlined in the joint venture agreement, dated 9 August, 1988.

- Record of North Meetings and Recommendations
- Development of a priority list of research initiatives
- Status reports on findings from field testing and demonstration projects
- Report on support provided to facilitate the adoption of new construction technologies, including energy efficiency(R2000), by NWT Housing Corporation.
- Compendium of Northern Building Problems and scientific solutions
- Documentation of the field investigation, analysis and reporting system field procedures manual
- Report on field investigations and concerns and problems in NWT housing
- Two energy efficient and CSA approved oil fired heating appliances tested and demonstrated for northern and remote Canadian Housing
- Assessment of integrated low power ventilation strategies appropriate for northern and remote Canadian Housing
- Report outlining the equations implemented for Level B analysis of the R2000 monitoring program.
- Development of an appropriate format to facilitate EMR/R2000 personnel to analyze data collected under Level B R2000 monitoring program.

SUMMARY OF DELIVERABLES

Deliverable: Record of North Meetings and Recommendations

This activity was handled through the secretariat position and included preparation of agendas for meetings, recording of minutes for meeting and facilitating information transfer to member agencies and individual committee members.

Four meetings of the NoRTH committee were held between January 01, 1988 and March 31, 1989

Appendix "B" contains the minutes of these meetings.

A core member list is attached plus a general mailing list of those individuals who have requested to be kept informed of the activities of the NoRTH Committee.

The group has expanded its visibility to include interest from Alaska, Newfoundland and Labrador and even Russia.

The NoRTH Committee is currently recognized as a sub-committee of the National Housing Research Committee(HRC) and is represented by Dick Bushell, NWTHC and Rob Duncan, CMHC.

The secretariat function was dependant on the joint venture agreement. Without an extension of the agreement, the secretariat function also ends. The committee raised serious concern regarding the proper functioning of the committee without a secretariat. Member agencies will be soliciting their own resources to try and secure funding of the secretariat.

Deliverable: Development of a priority list of research initiatives

Over the past year the following areas of research have been identified by various member agencies as priority areas for the north.

- Continued monitoring of high electrical bills reported in Yukon R2000 houses.
- Monitoring of Foundations movement especially the space frame
- Indoor Air Quality testing
- Improved window, door and hardware for the Arctic.
- Thermal Resistance Testing of NWT Wall Sections
- Moisture Pins study of framing in NWT houses
- Further investigation of DHW tanks as a space and water heating appliance
- Further testing of -40C HRV's
- Alternate Foundation systems
- Energy Efficient building packages
- Continued Airtightness retesting
- Further evaluation of Passive Ventilation for remote regions

Many of these research requests are currently being addressed in current research projects.

Deliverable: Status reports on findings from field testing and demonstration projects

The following is a summary of status of various project currently underway in the north.

Status Report:Field evaluation of the Energy Kinetics System 2000 Boiler

The System 2000 was ULC approved in the summer of 1988. A ULC listing was chosen because CSA approval was considered too expensive and the turnaround time was in the order of 6 months. ULC offered a fast turnaround for approval at a much cheaper price. The actual test procedure used by ULC is identical to that used by CSA. Enertech Mechanical was the sub-contract for that effort. No problems were encountered in securing ULC approval.

The System 2000 was installed in a Dawson City, Yukon R2000 Duplex in the fall of 1988. Ferguson, Simek, Clark was secured as the consultant to manage the contract.

A data acquisition system was installed in October and has been running since November 01, 1988. A copy of the first status report is included in Appendix "C". The report outlines the sensors that were installed on the System 2000 and HOT2000 runs for the duplex.

Data analysis has begun and an outline of data to be presented is also included in Appendix "C".

Monitoring is planned to continue until the spring of 1990.

A final report is planned for the fall of 1990.

Status Report:Field evaluation of the Heatslave Combi-Boiler

The Heatslave Combi-boiler manufactured by Worcester Engineering in England was imported into Canada in the spring of 1988. Enertech Mechanical was subcontracted to secure CSA equivalent listing for this product. Two major hurdles were encountered with this product.

a) The Heatslave had to be completely rewired to comply with Canadian electrical standards.

b) The boiler had to be retroffited with a CSA approved burner. A British Burner suitable for use with the Heatslave was not CSA approved. Attempting to CSA approve the boiler and burner was considered too difficult to achieve in time for the 1988/89

heating season.

A Riello burner was chosen. This burner was physically larger than the available space in the Heatslave. Additional sheetmetal work was required to house the burner and still retain the attractiveness of the boiler unit.

The first and only attempt to test the Heatslave to CSA standards resulted in a failure of the hot water storage tank. This is because the CSA standard requires a pressure test of 250 psi to the boiler(to verify weld integrity). Unfortunately, the integrated heat exchanger for the hot water tank also saw this pressure and subsequently failed. Apparently, the current CSA test procedure is not designed to handle an integrated system such as the Heatslave. A new test procedure would have to be developed. There was not enough budget to achieve this goal.

The Heatslave is currently located in Yellowknife. The original intention was to install this unit in the fire marshals new house, Kit Bell. Unfortunately the delays in trying to secure a CSA approved forced Mr. Bell to go with another boiler system. As a result, the references to Kit Bill in the progress report are now not relevant. A recent conversation with John Butler of EMR Yellowknife indicates that it may be possible to install the Heatslave in a test house in Yellowknife for a short period of time to get some field performance data on this unit.
We will be pursuing this avenue of opportunity in the upcoming year.

Status Report:Field evaluation of -40C HRV's

A Vanee -40C HRV is currently installed in the Dawson City duplex where the System 2000 is being monitored. The HRV is serving both sides of the duplex. Data is currently being collected by using a data acquisition system. Appendix "C" contains information regarding data being collected and planned analysis.

An arrangement has also been made to purchase four more - 40 HRV's for Yukon Housing Corporation. This will provide an opportunity for field validation of these units.

Status Report:Field evaluation of NWT passive ventilation system

An new NWT duplex has been selected for monitoring in Aklavik, NWT. Appendix "D" is a status report for this project.

The duplex utilizes the passive ventilation system. Data to be collected includes, temperature, relative humidity, flows in some of the ducts, delivered temperatures in some of the ducts and CO2

levels in the units. Delays in construction have delayed the start of this project. Monitoring was started in February of 1989.
Data will be collected until the summer of 1990.
Results of this project will complement a recent study by Rob Dumont conducted in the summer of 1988 and winter of 1988/89 to measure the thermal and flow characteristics of these passive ventilation systems.

Status Report: Data Collection of Moisture Content in Framing of NWT houses

Ferguson, Simek, Clark was responsible for installing moisture pins in 3 units in 3 communities in the NWT. These were: Fort Rae, Cambridge Bay, and Aklavik.

Appendix "E" is the Status report showing the locations for these moisture pins.

The responsibility of collecting the data is on NWTHC. Ferguson, Simek, Clark role in this project is now complete. Data will be forwarded to CMHC project manager Rob Duncan for analysis.

No fixed completion date has been set for this project. CMHC will continue to assist in the analysis of the data as long as NWTHC wishes to collect the data.

Status Report: Thermal Resistance Testing of NWT Wall Sections

A contract was secured with G.K Yuill to install guarded calorimeters ("Hot Boxes") on four wall section of NWTHC housing units. Four units were selected in Rankin Inlet for testing. Testing of two units began in early February and was completed in early March. The next two units were monitored in early March and testing will be complete in early April. Data analysis will begin in April.

Status Report:Field survey of improved window, door and hardware technology for the Arctic

A contract was secured by N. K. Larsson and Associates to secure information on the failure mechanisms of window, door and hardware currently being used in the north and suggest improvements in the technology. The project will be completed in the summer of 1989.

Status Report: Field Inspection of Domestic Hot Water tanks as combined space and water heating appliances.

A contract with Howell-Mayhew Engineering was secured to remove and inspect 3 domestic hot water tanks which were currently serving as combination space and water heating appliances.

The inspection was conducted in mid February in the presence of several people including the fire marshall, mechanical inspector, D. Bushell of NWTHC, and J. Butler of EMR.

Preliminary inspection suggested no apparent indications of premature failure. There does not appear to be any technical reason why these units cannot serve as combination appliances. Further investigation into impediments to having DHW tanks as combination appliances is still be conducted.

A final report is due in April of 1989.

Deliverable: Compendium of Northern Building Problems and scientific solutions

Over the past year, a concerted effort was placed on developing a resource document for the North Committee. The purpose of this document was to document all the Northern building problems, scientific solutions and failures in the north into a single document.

THe NoRTH File is the result of this effort and included in this report. The file is not complete. Some sections are more complete than others. The format for the document is reasonably well developed. Continued efforts next year are planned to complete the book.

The file contains background information in each subject area followed by "Factsheets" which describe recent or current projects underway in the subject area.

It is hoped that this document will serve as a vehicle for expediting information on research projects such as results (including interim and final) of those research projects.

The NoRTH File is identified by Appendix "F".

Deliverable: Assessment of integrated low power ventilation strategies appropriate for northern and remote Canadian Housing

This work was carried out by Rob Dumont as part of a separate contract with EMR. A copy of the report is included as Appendix "G" for convenience.

The only other related activity in this area is the target goals set out by the -40C HRV testing for the HRV fans. Indications are that these fans are now down to below 90 Watts and in most cases between 60 and 75 Watts.

No specific activity under this joint venture was initiated.

Deliverable: Report outlining the equations implemented for Level B analysis of the R2000 monitoring program.

A series of algorithms was developed describing the energy balance of the houses and performance parameters for the ventilation appliances. It was found that there is no standard Level B monitoring strategy in place. It was found that each house was being monitored in a slightly different way, the choice largely left up to the consultant. For example, there were three different methods of measuring below grade heat loss. As a result, three different algorithms had to be developed to accommodate these variations. In addition, even techniques for measuring flow varied from dedicated flow meters to relying on event signals only.

The original intention was to have these algorithms developed externally and then simply integrated into PILOT to allow on-line analysis. While a generic set of algorithms can be developed to accommodate the basic energy systems in the house, the uniqueness of many of the ventilation and heating systems would result in at least one or two custom algorithms that would have to be developed to accommodate these unique systems. This places a tremendous pressure on site validation of the algorithms while they are being developed. It was decided that to fully take advantage of on-line analysis, the consultant would have to commit a certain amount of time to this task. No budget was identified for this task. As a result, the integration of on-line analysis into all Level B projects was abandoned. It was decided however to utilize the equations developed for this task for data analysis after completion of the monitoring data.

It should be noted that on-line analysis was implemented in the Howell-Mayhew Cold climate house.

Appendix "H" contains the draft report showing the available algorithms.

It is recommended that in future monitoring contracts, if some form of analysis is defined before hand, such as the algorithms outlined in Appendix "H", this would serve as a baseline for consultants in not only defining the measurements for the task but also the sensors. This would facilitate more consistent monitoring protocols enabling on-line analysis and much easier efforts in comparing results from different projects.

CONCLUSIONS

THe CMHC/EMR Joint Venture will conclude on March 31, 1989. This joint venture has resulted in the initiation of several important and useful R&D projects in the north which are just beginning to produce data. CMHC will continue to manage these projects including analysis and presentation of results.

The past year has resulted in improved communication between north and south. The NoRTH committee has been the main vehicle for this improvement. It is felt that the committee is reaching maturity and continued committment by all member agencies is essential to maintain the momentum generated over the past year.

The NoRTH file is receiving a lot of attention from people interested in the residential technical issues in the north. The completion of this document will be a focus for next year.

A series of research projects are currently underway in the north directed at many of the priority issues identified through the north committee.

Future research in the areas of indoor air quality, space frame foundation monitoring, window, door and hardware for the north and continued evaluation of -40C HRV's is planned for 1989 under CMHC's own workplan.